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Cyclical and Structural Aspects of the Recent Export Trends: Evidence from Korea*

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Abstract

Purpose – This paper investigates the recent trade collapse, recovery, and prolonged slowdown to shed light on the discussions about whether the current slowdown is structural or cyclical. I examine structural, cyclical, and heterogeneous aspects of the recent trade trends using detailed statistics of a small open economy, South Korea, whose economic success and growth have been heavily dependent on exports.

Design/methodology – I use both aggregated and disaggregated trade statistics of South Korea. I apply the following methodologies: 1) I decompose the trade growth into the extensive and the intensive margin and observe the effect of prices over time. 2) I estimate the trade-income elasticities focusing on the world's import demand, separately for goods from the world and from Korea. 3) I compare the drop in goods exports in slowdown and trade collapse, which are the two unusual periods in the recent history when world trade has substantially dropped altogether.

Findings – I show that while the last drop of trade after 2015 has cyclical aspects, there is evidence that the continued slowdown from 2012 is structural: 1) the so-called 'China factor' is found in the analysis of trade-income elasticity of the world and China for imports from Korea. 2) The bilateral trade barriers between Korea and its principal trading partners are universally tightening. 3) Firm sizes, destination countries, and the mode of transactions affect disaggregated trade flows during the slowdown periods.

Originality/value – This paper contributes to the debate regarding whether the current trade slowdown is structural or cyclical. I provide two concrete evidence that the export drop in 2015 stems from low oil prices: one is the divergence of Korean export value index from its export quantity index, which started in late 2014 when oil prices plunged. I also contribute to the literature by providing evidence that Korea's trade barriers with important trading partners are steadily increasing since 2012 as the protectionist measures toward Korea's export products are steeply increasing after the global financial crisis.

Keywords: Great Trade Collapse, South Korea, Trade Barriers, Trade Slowdown
JEL Classifications: F14, O24

1. Introduction

In the last decade, world trade has experienced an unprecedented collapse, remarkable recovery, and persistent slowdown. At the end of the slowdown, the world trade entered another period of negative growth rate, which finally turned positive in late 2016. Fig. 1 presents the level and growth rate of exports of the world, South Korea, and its two largest trading partners, China and the US in the last decade. The trends in aggregate exports across the three countries are similar to those of the world.[1] The trends show distinct phases, which are quite different from the prolonged monotonic increase before the financial crisis of 2008-09.

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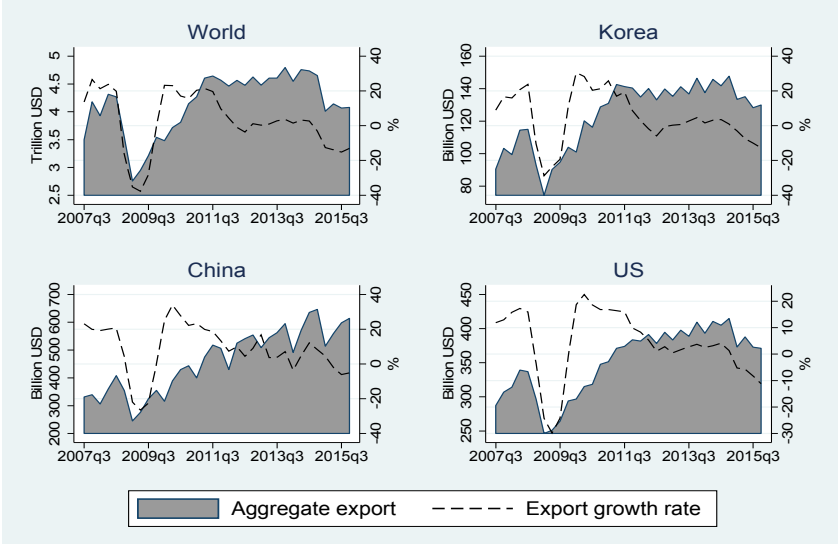
Fig. 1. The Export Trends in the Last Decade



Note: The left axis is the level of exports in USD, and the right axis is the quarter-on-quarter growth rate of exports.
Source: Authors' calculation using IMF Direction of trade statistics (DOTS) and CEIC database.

There are six distinct phases in the trends of Korean exports in the last decade, as in Table 1. The first period is pre-crisis when exports showed steady growth. The second period is crisis when exports collapsed by 39 percent.[2] The third period is recovery 1 when the volume of exports bounced back and reached beyond the pre-crisis level. The fourth period is slowdown when the volume of trade plateaued at around 4.6 trillion USD. The fifth period is drop when the volume of trade again fell by 9.5 percent, and the last period is recovery 2 when exports recovered from the drop.[3]

The dynamic behaviors of international trade in the previous decade worry policymakers and stimulate trade economists for its cause.4 In this paper, I focus on the recent trade collapse, recovery, and prolonged slowdown to shed light on the discussions about whether the current slowdown is structural or cyclical. I use detailed trade statistics of a small open economy, South Korea, whose economic success and growth have been heavily dependent on exports. Also, investigating South Korea's case may shed light on the recent fluctuations of the world trade. Since South Korea's export is heavily dependent on China and the U.S., Korea's export trend is known to be the 'barometer of the global manufacturing momentum' (Ro, 2012). Indeed, South Korea's quarter-on-quarter growth rate of aggregate export closely

[1] Although the exports volume of China look different from Korea and the US because of China's more pronounced seasonality. Historically, in China, exports of first quarter tend to be lower than other quarters, but China's trend of quarter-or-quarter export growth rate is similar to the world's export growth rate. Vietnam exhibits a same type of seasonality in export statistics.
[2] The quarter-on-quarter growth rate of world exports in 2009Q2 was 30 percent, which was the lowest growth rate in the modern history of the world trade
[3] Note that I call the fifth period's export drop as 'drop' throughout the paper.
[4] See Baldwin (2009), Bems et al. (2010) or Levchenko et al. (2010), for example.

move together with that of the world.[5]

Table 1. The Division of the Last Decade's Korean Exports into Six Sub-Periods

Name	Period	Growth Rate
Pre-crisis	2006q1-2008q3	14.2
Collapse	2008q4-2009q2	-20.9
Recovery 1	2009q3-2012q1	15.1
Slowdown	2012q2-2014q4	0.9
Drop	2015q1-2016q1	-9.5
Recovery 2	2016q2-2016q4	-3.4

Note: Before the trade collapse, the monotonic increase of international trade continued from 2002q1. (See Appendix for details.) I set the beginning of pre-crisis at 2006q1, from which disaggregated Korean statistics is available from TRASS. The growth rate refers to the average quarter-on-quarter export growth rate of each event in percentage.
Source: Authors' calculation using data from Trade Statistics Service of Korea.

I attempt to answer the following questions in this paper. The first question is whether the current trade slowdown is structural or cyclical. While there are studies on this topic as in Constantinescu et al. (2015) and Hoekman (2015), detailed reviews at a country level regarding the trade slowdown is rare as of now. To answer this question, I use the following methods. First, I analyze the relationship between oil prices and export prices of Korea to see their cyclical effect on export volumes. I decompose the trade growth into the extensive margin (the sum of entry and exit effect) and the intensive margin (the sum of quantity and price effects) and observe the impact of prices over time. Second, I estimate the trade-income elasticities focusing on the world's import demand, separately for goods from the world and from Korea. To address the serial correlations between the world trade and income statistics, I employ the error correction model. Third, I estimate the tariff-equivalent bilateral trade barriers between Korea and its principal trading partners. If the discussions about the new protectionism by scholars and policymakers have actual substance, the trend of trade barriers should be increasing.[6]

The second question I pose is regarding the heterogenous trade flows at a disaggregate level. I expect that, although the overall export has its distinct trend in each period, which I discuss more in detail in the next section, firm sizes, destination countries, and organization of firms affect trade flows at the disaggregated level. The literature reports that, during the Great Trade Collapse, the negative shock originated from the developed countries and spread through the global values chains Bussiere et al. (2013) and Eaton et al. (2016). I compare the drop in goods exports in slowdown and trade collapse, which are the two unusual periods in the recent history when world trade has substantially dropped altogether (Korea's annual exports fell by 20.9 percent during the collapse and 9.5 percent during the 2015 drop). Destination countries matter if the trade collapse originated from advanced countries, and the trade slowdown is due to the weak growth of emerging countries as UNCTAD (2016). Also, Bernard et al. (2009) show that intrafirm trade stayed resilient during the 1997 Asian financial crisis. I check whether Korea's intrafirm trade stayed resilient during the last decade as well. Since the Korean intrafirm trade statistics are inaccessible by policy, I combine the US related-party

[5] Korea's export growth rate is exceedingly close to that of the world compared to other small-open countries such as Australia and Chile or manufacturing-heavy countries such as Germany. See Appendix 1 for more details.
[6] See Evenett and Fritz (2015) for details.

trade statistics with Korean exports statistics to observe the intrafirm flows between Korea and the US.

Results show that, since 2012, meager oil prices drove down export prices, and the value of exports started diverging from the quantity of exports, which showed steady growth. The decomposition results indicate that the price effect was statistically significant only in 2015. Thus, the trade drop in the last two years largely stems from the price effects. The overall slowdown of trade, which started in 2012, however, seems to have structural aspects. The world's long-run income elasticity of imports from the world fell from 2.4 before the global crisis to 1.1 after the crisis. The world's long-run elasticity of imports from Korea also fell from 2.2 to 1.1. Also, the bilateral trade barriers between Korea and its principal trading partners have universally increased since 2012. Although the trade drop in 2015 appears to be temporary, there is a structural slowdown of world trade started in 2012, and Korea's sluggish exports in 2012-16 are in line with the world trend.

Regarding the heterogenous trade flows, I first find that large corporations are more resilient to both trade collapse in 2008 and the trade drop in 2015. Large firms' exports to emerging countries, however, fell relatively more in 2015 than in 2009, while small firms' exports to developing countries fell relatively less in 2015 than in 2009. Large firms' exports to emerging countries fell 5 percentage points more in 2015 compared to 2009, mostly because of weak intermediate goods exports. Small firms' exports to developing countries fell 7 percentage point less in 2015 compared to 2009. Korea's intrafirm exports to the US deeply dropped in but also quickly recovered from the Great Trade Collapse. Intrafirm exports fell by 47 percent in 2009 but recovered by 55 percent in 2010, while arm's length trade fell by 8.3 percent in 2009 and recovered by 0.6 percent in 2010. Intrafirm trade stayed more stable during the trade slowdown. When I decompose the intrafirm exports' growth rate into the quantity, price, entry, and exit effects, all of them stayed far more stable than those of arm's length exports throughout the last decade.

This paper contributes to the debate regarding whether the current trade slowdown is structural or cyclical. I provide two concrete evidence that the export drop in 2015 stems from low oil prices: one is the divergence of the Korean export value index from its export quantity index, which started in late 2014 when oil prices plunged. The export prices fell so much that while the export quantity index was growing, the export value index was diminishing. The other evidence is the decomposition results that price effect is significant only in 2015. Therefore, the drop in trade in 2015 looks mostly cyclical. While the literature widely discusses trade slowdown, this paper is the first one to specifically address the trade drop in 2015 and its causes to the best of my knowledge.

I also contribute to the literature by providing evidence that the slowdown of trade from 2012 has structural aspects. I find the 'China factor' in the drop of trade-income elasticity after the global financial crisis, by showing that the pattern of the world's trade-income elasticity for imports from Korea (as well as for imports from the world) is similar to that of China. At the same time, there is evidence that Korea's trade barriers with important trading partners are steadily increasing after 2012. Trade barriers have been growing with the protectionist measures toward Korea's export products are steeply increasing after the global financial crisis.[7]

Overall, the paper confirms the slowdown using Korean statistics as above but offers more detailed analyses of the phenomenon. The study compares trade slowdown with other recent

[7] According to Korea International Trade Association (http://ntb.kita.net), the number of protectionism measures including anti-dumping, safeguards, and countervailing duties toward Korean products has increased from 4 in 2010 to 42 in 2016.

changes in the trade trend, namely trade collapse in 2007-09 (before trade slowdown) and trade drop in 2015 (after trade slowdown). According to Section 2, both trade collapse and trade drop seem to be temporary shocks, unlike slowdown. Export value collapsed due to the fall in both quantity and price during the trade collapse, but the decline of export value during the recent drop in 2015 is due to the reduction in the price. Such a comparison between trade drop and trade collapse is new to the literature to the best of my knowledge.

Also, I show that the structural slowdown of trade accompanies the increases in bilateral trade barriers except for the barriers between Korean and Vietnam. The finding conveys a policy implication for Korea regarding the anticipated difficulties and opportunities for Korean exporting firms. Lastly, I show that despite the overall slowdown of international trade in recent years, the extent of the slowdown depends on firm characteristics. According to the results in Section 4, the slowdown was more severe for smaller firms rather than large firms. The fact that intrafirm trade is more stable also shows that smaller firms might have more fluctuations in exporting because large firms tend to do more intrafirm trade.

The trend of international trade has changed after the global financial crisis, and it is unlikely that the world's trade or Korea's trade grow soon as they did before 2007. Policymakers, however, can still find ways to strengthen Korea's export growth. Diversifying export products will make export flows less susceptible to oil price fluctuations. Since export prices of homogenous goods fluctuate more along with oil prices, increasing the share of heterogeneous goods in total will be helpful for stabilizing export flows. Also, the finding that trade barriers with Vietnam are steadily decreasing suggests that the relationship with ASEAN countries will be more critical for Korea in the future. It is advisable to utilize further the Korea-Vietnam and Korea-ASEAN FTAs, whose utilization rate is 52.3 percent and 36.0 percent as of 2016, and enhance the economic cooperation between Korea and ASEAN.

2. Cyclical Aspects of the Trade Drop in 2015

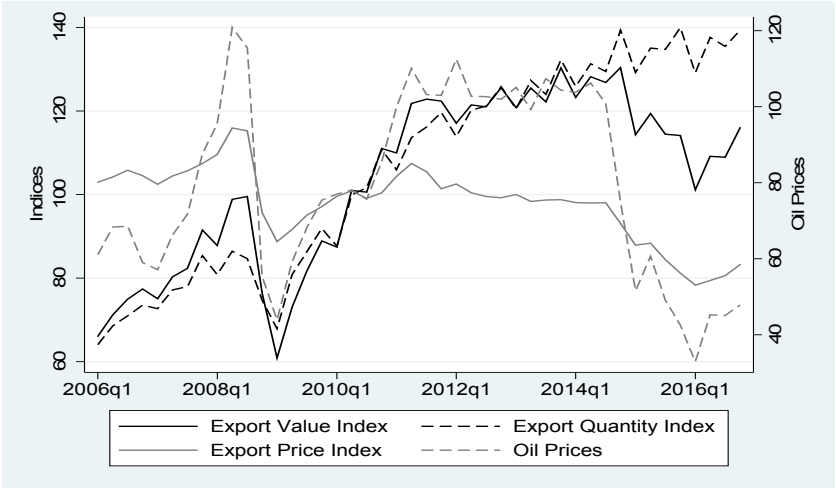
Korean exports dropped by -9.5 percent during the drop period in Table 1. The decline in exports was a rare event. If the drop were a cyclical and temporary event, then the volume of trade would recover eventually. If, however, the drop has a structural aspect that fundamentally changes the volume of exports, then the drop has more long-term implications. Therefore, it is essential to understand whether the export drop in 2015 was cyclical or structural.

Given that the oil prices sharply dropped since 2014, it is likely that the drop was cyclical. To investigate the cyclical aspect of the trade drop, I first decompose the export volume into trade quantity and price. Since the quantity and price of exports determine the total value of exports, decomposing the trade values into quantity and price may inform whether the drop of overall value stems from lower prices or lower quantity of transactions. If the total value of exports dropped due to lower prices, then it is more likely that the exports fell due to a cyclical reason. If the value of exports fell due to the declined quantity of physical transactions, then it can be due to either cyclical or structural reasons.

To decompose the total trade volume into quantity and prices, I use the export price, quantity, and volume index, which are available from the Bank of Korea. Fig. 2 clearly shows that the trade drop in 2015 was due to lowered export prices. The black solid line is the export value index, which started to drop in 2015. The export volume can be decomposed to export price index in the gray solid line and export quantity index in the black dotted line. The three indexes are normalized to be 100 in 2010. Since then, the export volume index and export quantity index increased together while the export price index staggered. At the same time,

oil prices staggered. Since mid-2014, both the export price index and oil prices started to plunge, and in mid-2015, the export volume index also started to drop. The export quantity index, however, continued to increase.

Fig. 2. Export Indexes and Oil Prices



Note: The left axis indicates the level of export value, quantity, and price indices, whose yearly averages are normalized to be 100 in 2010. The right axis indicates oil prices in USD per barrel. Oil prices are the average of Dubai crude oil, Brent crude oil, and West Texas Intermediate.

Source: Authors' calculation using data from the Bank of Korea and Korea Statistical Information Service.

In short, while the export volume dropped in 2015, export quantity continued to increase. Thus, the drop in exports stems from a decline in export prices rather than a decrease in physical export transactions. Therefore, the drop in 2015 is likely to be a cyclical event that may recover with oil prices. Note that we cannot determine whether the relationship between oil prices and export prices is causal.

To formally investigate the cyclical nature of the trade drop in 2015 sketched above, I use more detailed export data and analyze the contribution of price effects to the export drop. Specifically, I decompose year export growth into intensive margin (the sum of price effect and quantity effect) and extensive margin (the sum of entry effect and exit effect). In this way, I can calculate the numerical contribution of the price effect on the trade drop in 2015.

The methodology is from Haddad et al. (2010), but I apply a mid-point method when calculating the growth of exports in the spirit of Eaton et al. (2008).[8] The starting point of the decomposition is the following identity, $V_d(t) = \sum_j v_d(j,t)$, where the volume of exports from Korea to destination country d at year t is the sum of exports of each products i, $v_d(j,t)$. Furthermore, the volume of exports of product j is price $p_d(j,t)$ times quantity $q_d(j,t)$ of the product, $v_d(j,t) \equiv p_d(j,t)q_d(j,t)$. Therefore, the total volume of Korean exports in year t to destination country d is $V_d(t) = \sum_j p_d(j,t)\, q_d(j,t)$. The yearly growth

[8] Eaton et al. (2008) claim that using th average value of the two periods is beneficial since values close to zero in the first year would give less extreme effects. Also, instead of applying the method to all imports of a country, I apply it to all exports of Korea to each destination.

rate of trade volume when applying the mid-point method is then $\frac{V_d(t)-V_d(t-1)}{M}$, where $M \equiv [V_d(t-1)+V_d(t)]/2$ is the mid-point or average of the two years. The numerator is the absolute difference between the export volume in year t and year $t-1$. The volume of export may change from year to year because of an increase or decrease in existing export relationships (intensive margin), entry of new relationships, or exit of old relationships.

I define C_d^t as the set of products Korea continues to export from year $t-1$ to t to destination country d. N_d^t is the set of entering products, which are exported to d in the present year t but not in the previous year $t-1$. E_d^t denotes the set of exiting products, which are exported to d in the previous year $t-1$ but not in the present year t. Also, I define nC_d^t as the number of products in the set C_d^t; nN_d^t as the number of products in the set N_d^t; nE_d^t as the number of products in the set E_d^t. Then the difference in export volume between two years can be written as the following:

$$GR_{td} = \underbrace{QE_{td} + PE_{td}}_{intensive\ margin} + \underbrace{EE_{td} + XE_{td}}_{extensive\ margin}, \tag{1}$$

where

$$GR_{td} = \frac{V_d(t) - V_d(t-1)}{M}$$

$$QE_{td} \equiv \frac{1}{M}\sum_{j \in C_d^t} \frac{p_d(j,t) + p_d(j,t-1)}{2}[q_d(j,t) - q_d(j,t-1)]$$

$$PE_{td} \equiv \frac{1}{M}\sum_{j \in C_d^t} \frac{q_d(j,t) + q_d(j,t-1)}{2}[p_d(j,t) - p_d(j,t-1)]$$

$$EE_{td} \equiv \frac{1}{M}\sum_{j \in N_d^t} p_d(j,t)q_d(j,t)$$

$$XE_{td} \equiv \tfrac{1}{M}\textstyle\sum_{j \in X_d^t} p_d(j,t-1)q_d(j,t-1).$$

GR_{td} is the yearly growth rate of exports, which is the percentage difference in export volume between two consecutive years. QE_{td} is the quantity effect, which the difference in the quantity of export times the average price of the two years. PE_{td} is the price effect, which is the difference in the export price times the average quantity of the two years. Therefore QE_{td} shows the change in export volume due to the export quantity of continuing product-country pairs; PE_{td} shows the change in export volume due to the export price of staying product-country pairs. The sum of the two terms is equivalent to $\frac{1}{M}\sum_{j \in C_d^t}[p_d(j,t)q_d(j,t) - p_d(j,t-1)q_d(j,t-1)]$, which is the intensive margin of the total change in export volume. EE_{td} is the entry effect, which is the increase in the export volume between the two years due to the entry of new product-country pairs. XE_{td} is the exit effect, which is the decrease in the export volume between the two years due to the exit of product-country pairs between the two years. The sum of the last two terms is the extensive margin of the total change in export volume. Note that the equation is divided by M to show the percentage of each effect. Since each effect is a sum across products j, each term in the right-hand side of equation (1) then has two dimensions: year and country.

To quantify the size and significance of each effect on the yearly growth of exports, I regress the growth rate by each margin for each year. Specifically, I run the set of four regression equation for each year:

$$QE_{td} = \alpha_1 + \beta_1 GR_{td} + \epsilon_{1td}$$
$$PE_{td} = \alpha_2 + \beta_2 GR_{td} + \epsilon_{2td}$$
$$EE_{td} = \alpha_3 + \beta_3 GR_{td} + \epsilon_{3td}$$
$$XE_{td} = \alpha_4 + \beta_4 GR_{td} + \epsilon_{4td}.$$

Each coefficient β shows the percentage contribution of each effect. Since equation (1) is an identity, the sum of four coefficients would be equal to unity, i.e. $\beta_1 + \beta_2 + \beta_3 + \beta_4 = 1$ for each year.

I use disaggregated Korean exports data from the Trade Statistics Service (TRASS), which collects all exports and imports information from the Korean Customs. The export statistics are classified at Korean Harmonized System (KHS) 10-digit level, but, for better concordances, I aggregate them at HS 6-digit, which have 4,386 products. Since there was a revision of the Harmonized System in 2012, I convert the 2012 system to 2007 using the concordance table from the United Nations Statistics Divisions. Table 2 lists the average and standard deviation of products in continuing, entry, and exit groups. The sample years range from 2007 to 2016. The number of products in the continuing group has plateaued between 2015-16, while that in entry (exit) group slightly increased (decreased).

Table 2. The Numbers of Continuing, Entry, and Exit group

Year	Continuing		Entry		Exit	
	Mean	SD	Mean	SD	Mean	SD
2006-2007	260.1	466.9	116.9	128.0	96.0	102.0
2007-2008	286.3	497.0	109.5	113.3	94.0	96.9
2008-2009	287.0	498.2	108.3	112.0	103.7	108.5
2009-2010	294.3	509.2	117.1	122.2	95.8	97.1
2010-2011	308.6	525.3	114.0	117.6	101.1	105.2
2011-2012	317.6	535.3	113.6	115.0	101.4	102.8
2012-2013	330.6	550.9	120.4	120.4	100.6	99.3
2013-2014	345.4	561.7	124.2	120.9	105.7	102.6
2014-2015	353.9	570.0	115.6	111.5	115.7	110.4
2015-2016	353.9	574.8	120.9	118.2	113.6	109.8

Note: Each row reports the mean and standard deviation of the number of continuing (nC_d^t), entry (nN_d^t), and exit (nE_d^t) group across countries.
Source: Authors' calculation using data from TRASS.

Table 3. OLS Results - Effect of Margins on Export Growth

Year	Quantity	Price	Entry	Exit	N. of Obs.	
					Reg.	Base
2006-2016	0.189 **	0.0113	0.442 ***	-0.356 ***	241	242,324
	(0.0855)	(0.0780)	(0.0279)	(0.0342)		
2006-2007	0.269 ***	-0.0215	0.338 ***	-0.415 ***	230	210,500
	(0.0549)	(0.0287)	(0.0521)	(0.0502)		
2007-2008	0.338 ***	-0.0469	0.348 ***	-0.361 ***	228	222,021
	(0.0826)	(0.0474)	(0.0587)	(0.0623)		
2008-2009	0.294 ***	-0.0388	0.419 ***	-0.299 ***	231	230,476
	(0.0475)	(0.0246)	(0.0467)	(0.0480)		

Table 3. (Continued)

Year	Quantity	Price	Entry	Exit	N. of Obs.	
					Reg.	Base
2009-2010	0.234 ***	-0.0380	0.36 ***	-0.415 ***	234	237,773
	(0.0475)	(0.0246)	(0.0531)	(0.0509)		
2010-2011	0.164 ***	0.0123	0.43 ***	-0.394 ***	235	246,035
	(0.0320)	(0.0165)	(0.0542)	(0.0476)		
2011-2012	0.258 ***	-0.0245	0.361 ***	-0.404 ***	237	252,796
	(0.0515)	(0.0295)	(0.0532)	(0.0563)		
2012-2013	0.232 ***	-0.0382	0.496 ***	-0.311 ***	237	261,637
	(0.0505)	(0.0284)	(0.0577)	(0.0531)		
2013-2014	0.432 ***	-0.123	0.3 ***	-0.391 ***	237	273,101
	(0.111)	(0.0770)	(0.0518)	(0.0630)		
2014-2015	0.405 ***	-0.166 **	0.413 ***	-0.347 ***	237	277,610
	(0.100)	(0.0842)	(0.0508)	(0.0582)		
2015-2016	0.0407	0.180	0.489 ***	-0.289 ***	238	278,633
	(0.202)	(0.192)	(0.0522)	(0.0524)		

Notes: 1. The independent variable is the growth rate by country in all cells. Robust standard errors in parentheses.
2. *p<0.1, **p<0.05, ***p<0.001.
Source: Authors' calculation using data from TRASS.

Table 3 presents the results of the set of four regressions for each year. The four effects are from the decomposition of the growth rate of the present year from the previous year. The base dataset for each year contains the non-zero export flows at the KHS 6-digit product, country, and (the current and previous) year. The number of observations of the base dataset ranges between 210,500 to 278,633. Since each effect is equation (1) is aggregated across products for each country and year, the number of observations for the regressions is equal to the number of Korea's export destination countries, which ranges from 228 to 241.

The first row of Table 3 exhibits the decomposition results of export growth between 2006 and 2016, i.e., $t = 2016$ and $t - 1 = 2006$. Overall, therefore, the quantity effect contributed 19 percent of the growth and price effect contributed 1 percent, which means that the impact of the intensive margin contributed 20 percent to the increase between 2006 and 2016. The contribution of the extensive margin is 80 percent. The smaller contribution of intensive margin compared to extensive margin is because I consider all trading partner countries with equal weight.

Although the price effect on export growth between 2006 and 2016 is statistically insignificant and small in absolute size, it increases in absolute values after 2013. The price effect increases from -3 percent in 2013 to -12 percent in 2014 and -17 percent in 2015. Also, the relationship between the export growth rate and the price effect is significant at 5 percent level in 2015. Such trends during the periods of slowdown and drop are consistent with the export price index of Korea that starts diverging from the export quantity index as oil prices plunge.

Therefore, the substantial price effect is a distinct feature of the trade drop in 2015. The decomposition analysis shows the strong negative price effect on export growth, which is rare in the last ten years and disappears in 2016. Note that during the Great trade collapse in 2009,

the price effect was small and insignificant. Such a result is consistent with Gopinath et al. (2012), who show that prices stayed stable during the GTC.

3. Structural Aspects of the Trade Slowdown

I turn to investigate the structural aspects of the trade slowdown in this section. I mainly show that the trade-income elasticity slowed down and that bilateral trade barriers increased.

3.1. Trade-Income Elasticity

I estimate the world's income elasticity of imports from Korea. The trade-income elasticity literature generally measures the income elasticity of imports using the world's imports and GDP statistics. I apply this concept to the case of Korea and measure how the world's import demand for Korean goods responds to the world's income. I use a wildly used version of the error correction model, which can address the serial correlation between the GDP and trade flows (Constantinescu et al., 2015). The specification is

$$\Delta m_t = \alpha + \beta_1 m_{t-1} + \beta_2 \Delta y_t + \beta_3 y_{t-1} + \epsilon_t \quad (2)$$

where α is a constant, m is the log of the world's import from Korea (or Korean exports to the world) in time t, y_t is the log of the world's income (GDP) at time t, Δ denotes the first difference. The model is based on the simple relationship of trade and GDP, $M_t = QY_t$, where imports (M_t) is a proportion (a constant Q) of GDP (Y_t). Some algebra shows that, in equation (2), β_2 is the short-run trade elasticity, $-\beta_3/\beta_1$ is the long-run trade elasticity, and β_1 is the speed of adjustment of import to GDP, or the error correction term.[9] The Phillips-Perron unit root test rejects the hypothesis that the first differences of import (Δm) and income (Δy) have unit roots as in Table B. The rank of cointegration of the two series is one according to the Johansen test as in Table C. These test results justify the use of the error correction model in equation (2).

I use quarterly statistics of trade from IMF DOTS and GDP from Bloomberg to run the error correction model in equation (2). Since I give special attention to how the long-run trade-income elasticities are shifting before and after the global financial crisis, I divide the total periods into 2000q1-2008q4 and 2010q1-2016q2. In addition to the world's income, I calculate the sensitivity of trade concerning incomes and imports of China, the US, and the European Union. For each economy, I separate the elasticity concerning imports from Korea and imports from the world.

Table 4 presents the estimation results of the error correction model when considering how the imports from Korea and the imports from the world respond to the changes of the importing party's income in the case of the world, China, US, and EU. The first two columns of Panel A present the case when the importing party is South Korea, and the next two columns of panel A show how the world's imports respond to the world's income before and after the crisis.

I analyze the results mainly in two aspects: the change in the significance of the beta coefficients, β_1, β_2, and β_3, and the change in the level of the long-run elasticity. If the relationship between trade and income gets weaker after the global financial crisis, I would

[9] See Escaith et al. (2010) for the detailed derivation of the short-run and long-run trade elasticity from the simple relationship $M_t = QY_t$.

observe either statistically insignificant coefficients or significant but lower implied long-run elasticity. In Panel A, the long-run trade-income elasticity of the world for imports from Korea became weaker after the global financial crisis. In the first column of panel A, all three coefficients are statistically significant at 1 percent, and the long-run elasticity is 2.354. But in the second column of Panel A, the coefficients are mostly insignificant, and the elasticity went down to 1.052. Thus, the relationship between trade and income became weaker in two aspects: the coefficients became insignificant, and the level of trade-income elasticity fell.

Table 4. Estimation Results of the Error Correction Model

A. World

Import from	**Korea**		**World**	
Period	**00q1-08q4**	**10q1-2016q2**	**00q1-08q4**	**10q1-16q2**
m_{t-1}	-0.783 ***	-0.42 *	-0.999 ***	-0.15
	(0.15)	(0.23)	(0.27)	(0.18)
Δy_t	1.904 ***	0.848	1.296 ***	1.516 ***
	(0.54)	(0.66)	(0.43)	(0.49)
y_{t-1}	1.843 ***	0.442	2.184 ***	0.17
	(0.34)	(0.52)	(0.57)	(0.39)
Observations	31	26	31	26
R-squared	0.539	0.291	0.681	0.451
LR Elasticity	2.354	1.052	2.186	1.133

B. China

Import from	**Korea**		**World**	
Period	**00q1-08q4**	**10q1-2016q2**	**00q1-08q4**	**10q1-16q2**
m_{t-1}	0.0408	-0.115	0.0668	-0.192
	(0.07)	(0.12)	(0.12)	(0.13)
Δy_t	0.336 ***	0.485 ***	0.296 *	0.35 **
	(0.10)	(0.07)	(0.15)	(0.13)
y_{t-1}	-0.118	-0.0094	-0.152	-0.049
	(0.11)	(0.07)	(0.18)	(0.09)
Observations	35	26	35	26
R-squared	0.358	0.729	0.253	0.51
LR Elasticity	2.892	-0.082	2.275	-0.255

C. US

Import from	**Korea**		**World**	
Period	**00q1-08q4**	**10q1-2016q2**	**00q1-08q4**	**10q1-16q2**
m_{t-1}	-0.356 **	-0.835 ***	-0.353 **	-0.35 **
	(0.14)	(0.17)	(0.17)	(0.13)
Δy_t	5.192 ***	8.449 ***	3.645 **	5.52 ***
	(1.56)	(2.67)	(1.42)	(1.67)
y_{t-1}	0.393 **	1.495 ***	0.639 **	0.0998
	(0.17)	(0.26)	(0.30)	(0.12)
Observations	35	26	35	26
R-squared	0.397	0.59	0.419	0.483
LR Elasticity	1.104	1.79	1.81	0.285

Table 4. (Continued)

D. EU

Import from	**Korea**		**World**	
Period	**00q1-08q4**	**10q1-2016q2**	**00q1-08q4**	**10q1-16q2**
m_{t-1}	-0.314 ***	-0.702 ***	-0.467 ***	-0.582 ***
	(0.10)	(0.16)	(0.15)	(0.19)
Δy_t	0.516 **	0.481	0.645 ***	0.568 ***
	(0.22)	(0.51)	(0.14)	(0.12)
y_{t-1}	0.427 ***	0.351	0.573 ***	0.826 ***
	(0.12)	(0.34)	(0.17)	(0.24)
Observations	35	26	35	26
R-squared	0.325	0.328	0.538	0.557
LR Elasticity	1.36	0.5	1.227	1.419

Notes: 1. The name of the economy on top of each panel indicates the subject of the trade-income elasticity. For each economy, I separately calculate the elasticity for imports from Korea (the first three columns) and imports from the world (the next three columns). Robust standard errors in parentheses.

2. *p<0.1, **p<0.05, ***p<0.001.

Source: Authors' calculation using data from IMF DOTS and Bloomberg.

I observe the same pattern in the next two columns. The long-run trade-income elasticity of the world for imports from the world fell from 2.186 before the crisis to 1.133 after the crisis. The coefficients became mostly insignificant after the crisis except for β_2. Thus, the results of the trade-income elasticity of the world show that the increase of income creates lower trade after the global financial crisis than before the crisis, and the relationship itself between trade and income became weaker.

The results slightly vary at the country level. In Panel B, where I present the results for China, the long-run trade-income elasticity for imports from Korea (to China) fell down from 2.892 to -0.082 after the crisis. The elasticity for imports from the world (to China) also fell down from 2.275 to -0.255. China's decreasing pattern of elasticity is the same as the case of the world, implying that China played an important role in shaping the pattern of the decreasing trade-income elasticity. In Panel B, however, both β_1 and β_3 are insignificant in all four columns. It implies that, in the case of China, the relationship between the current import growth and the lagged GDP or lagged imports vary a lot. Thus, the long-run elasticity of China is calculated based on statistically insignificant coefficients, but China's decreasing pattern of elasticity is similar to the world's.

In Panel C, where I present the results for the US, the long-run trade-income elasticity for imports from Korea (to the US) has increased (from 1.104 to 1.79), and all coefficients are statistically significant both before and after the crisis. The stronger relationship between US income and its imports from Korea is impressive since the elasticity for imports from the world went down from 1.810 to 0.825 and β_3 is insignificant in the sixth column. The long-run elasticity of the US for Korean imports may have increased due to the Korea-US (KORUS) FTA, which came into effect since 2012.

In the last panel, I present the results for the EU. The trade-income elasticity for imports from Korea (to the EU) has the same pattern as the case of the world: β_2 and β_3 are significant before the crisis but insignificant after the crisis, and the elasticity went down from 1.360 to 0.5. The elasticity for imports from the world (to the EU), however, slightly went up after the crisis, from 1.227 to 1.419. Also, all coefficients are significant both before and after the crisis.

To sum up, the relationship between the world's income and the world's imports from both the world and Korea became weaker after the financial crisis. Such trends are consistent with that of China, which confirms 'the China factor' in the slowdown literature (Hoekman, 2015). The long-run trade-income elasticity went down in all cases except for the elasticity of the US for the imports from Korea and the elasticity of the EU for the imports from the world. Further investigations regarding why there are such exceptions are out of the scope of this paper but could be a future research topic.

3.2. Bilateral Trade Barriers

The second analysis to check the structural changes in international trade of South Korea in terms of trade barriers. I hypothesize that the trade slowdown can be due to a systematic increase in trade barriers that South Korea faces. To investigate this hypothesis, I calculate the bilateral trade barriers between South Korea and its major trading partners. Table 5 lists the top ten crucial trading partners measured by the share of the bilateral trade between Korea and the partner country out of the total international trade of South Korea. China is by far the largest trading partner of South Korea regardless of whether the trade share is measure by export or import. The United States, Japan, Vietnam, and other countries follow.

Table 5. Top Ten Trading Partners of Korea in 2015

Country	Export Share	Import Share	Total Share
China	26.0	20.7	23.6
United States	13.3	10.1	11.9
Japan	4.9	10.5	7.4
Vietnam	5.3	2.2	3.9
Hong Kong	5.8	0.3	3.3
Saudi Arabia	1.8	4.5	3.0
Taiwan	2.3	3.8	3.0
Australia	2.1	3.8	2.8
Germany	1.2	4.8	2.8
Singapore	2.8	1.8	2.4

Note: Export share is the share of Korean exports to the partner country out of the total Korean exports. Import share is the share of Korean imports from the partner country out of the total Korean imports. Total share is the share of the sum of import and export between Korea and the partner country out of the total export and import of Korea.} All units are percentage. The total Korean export in 2015 is 527 billion USD, and the total import is 436 billion USD.

Source: Authors' calculation using data from IMF DOTS.

To calculate the bilateral trade barriers between Korea and its important trade partners, I adopt the methodology of Novy (2013). He derives an analytical way from the gravity equation to measure bilateral trade barriers. The trade barriers conceptually measure the costs of international trade compared to domestic trade. As I discuss later in this section, the methodology measures the amount of international trade that is not explained by the gravity equation. The main benefit of the approach is that it allows one to calculate bilateral trade barriers using directly observable statistics, which are GDPs and bilateral trade. Specifically, the tariff equivalent trade barrier between country i and country j is derived as the following:

$$\tau_{ij} \equiv \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{\frac{1}{2}} - 1 = \left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1 \quad (3)$$

where t_{ij} is trade cost that country i faces when exporting to country j, and x_{ij} is country i's export to country j; t_{ii} is country i's domestic trade costs. Similarly, x_{ii} captures country i's domestic sales of its total production, which is defined as $x_{ii} \equiv y_i - \sum_j x_{ij}$, where y_i is the aggregate goods production of country i. The parameter σ is the elasticity of substitution.

Calculating trade barriers requires international and domestic trade statistics. While bilateral trade statistics are readily available from the IMF Direction of Trade Statistics (DOTS), national trade statistics need to be constructed. Domestic trade refers to goods that a country exports to itself (or products that a country imports from itself), as x_{ii} is defined. The crucial part of measuring x_{ii} is to construct the aggregate goods production y_i. Since bilateral trade statistics are gross shipments, which include intermediate goods, the aggregate goods production needs to be in terms of gross output. OECD Structural Analysis (STAN) database offers the statistics, but its time coverage is limited to 2011. Therefore, I take the three-step approach of Wei (1996) to construct the aggregate production.[10] The first step is to collect the goods part of the quarterly nominal GDP, which generally includes agriculture, mining, and manufacturing. I obtain the statistics from each trading partner country's statistics bureau.[11] The second step is to compute the ratio between shipment and value-added using the OECD STAN database. The third step is to calculate the aggregate goods production as

$$(\text{aggregate goods production}, y_i) = \frac{(\text{shipment})}{(\text{value added})} \times (\text{goods part GDP})$$

The value of elasticity of substitution σ, is known to range between 5-10 in the literature. I set $\sigma = 8$, but the overall trends are robust to different numbers within the range.

Fig. 3 shows the recent trends of bilateral trade costs between Korea and its trading partners. The vertical axis indicates the level of bilateral trade barriers in terms of tariff equivalence. Since the value of trade barriers is sensitive to the assigned value of elasticity of substitution, it is more appropriate to interpret the tariff equivalent values as a relative measure. The main finding in the results in Fig. 3 is that the bilateral trade barriers are increasing in most of the top trade partner countries since the beginning of the global trade slowdown around 2011. As Table 6 shows, the increasing trend of bilateral trade barriers is common to most trade partner countries. Trade barriers with large countries tend to increase smaller: the tariff equivalent trade barrier rises 2 percentage points for China, 1 percentage point for the United States, and 3 percentage points for Germany between 2012 and 2016.

On the contrary, the barriers with middle or smaller countries tend to increase over 10 percentage points. The decrease in trade barriers with Vietnam is exceptional. Over the periods of the Great Recession and global trade slowdown, the trade barriers with Vietnam have consistently decreased from 2000. It is related to the exceptional growth of and trade with Vietnam over the past decade.

From the results, it is clear that the bilateral trade barriers that Korea faces have increased during the period of the global trade slowdown. It is worth noting that the trade barriers are increasing altogether, except for Vietnam. The trend shows that the cost of international trade is increasing relative to the cost of domestic transactions. While Korea's foreign trade

[10] UN ESCAP and World Bank jointly constructed the annual International Trade Costs database using the approach of Novy (2013), but the time coverage is still limited to 2013 as of now. Since I focus on the recent trade slowdown and the collapse of trade, I calculate the trade costs until 2016.

[11] See appendix for detailed information about the coverage of the goods part of GDP and data source for each country.

plateaued between 2012 and 2014, the trade barriers were growing. In this context, the steady decrease of the trade barrier with Vietnam emphasizes the importance of the relationship between Korea and Vietnam.

Fig. 3. Korea's Bilateral Trade Barriers in Terms of Tariff Equivalence

Note: The unit of trade barriers is tariff equivalence. The 2016 values are the average of the first and second quarters of the year, while all other values are the yearly average of the four quarters. Data for Saudi Arabia is available from 2010.

Source: Authors' calculating using data from IMF DOTS, Bloomberg, Bank of Korea, Census and Statistics Department of Hong Kong, Department of Statistics Singapore, OECD Structural Analysis database.

Table 6. Change in Bilateral Trade Barriers between 2012 and 2016

Country	2012	2016	Difference
China	0.56	0.58	0.02
United States	0.79	0.80	0.01
Japan	0.70	0.80	0.10
Vietnam	0.69	0.59	-0.09
Hong Kong	0.42	0.53	0.11
Saudi Arabia	0.66	0.76	0.10
Taiwan	0.36	0.58	0.22
Australia	0.66	0.76	0.11
Germany	0.63	0.65	0.03
Singapore	0.32	0.58	0.26

Note: The unit of trade barriers is tariff equivalence.

Source: Authors' calculation using trade barriers in Fig. 3.

There is a caveat when interpreting the trade barrier results. The Novy (2013) method considers all trade flows that are unexplained by the gravity equation as trade barriers, which is similar to the concept of the Solow residuals. Thus, the trade barriers could be overestimated if the global value chains have shrunken after 2011, which is the last year that OECD STAN offers the actual ratio of shipment and value-added. Unfortunately, the actual information on the gross shipments after 2012 is unavailable as of now. But when I use GDP instead of gross shipments to estimate the trade barriers, the increasing pattern is consistent with the current results. Therefore, while trade barriers seem to be increasing after 2012, the magnitude could be adjusted when actual gross-shipment statistics are available.

4. Heterogeneous Aspects of the Trade Slowdown

This section consists of two analyses that investigate the heterogeneous aspects of the recent trade slowdown. The first analysis tests whether the extent of trade slowdown is heterogeneous depending on the income level of export destination countries and the size of the exporting firms. The second analysis examines whether the degree of trade slowdown depends on whether the trade flows are between related firms or between independent firms. The results show that such heterogeneities in trade slowdown do exist.

4.1. Destination Countries and Firm Sizes

In this section, I ask whether the trade slowdown is concentrated on trade with emerging countries. UNCTAD (2016) claims that the trade slowdown is more severe in emerging countries, while the Great Trade Collapse in 2008-09 started from the developed countries and spread to the rest of the world through the global value chains. I test whether trade between Korea and emerging countries fell more than trade between Korea and developed countries. I compare the trade growth rate in the trade drop in 2015 and the midst of the trade collapse in 2009. While the aggregate trade more severely dropped during the financial crisis than during the trade slowdown, the effect of destination country could be different in the two periods because of the different origins of the shocks.

I employ the difference-in-differences method in line with Ariu (2016) to test whether the effect of destination countries on export growth is different in 2009 and 2015 as below:

$$\Delta v_{jidt} = \alpha + \beta_0' T_t + \beta_1' W_{dt} + \beta_2' W_{dt} \times T_t + \delta_i + \epsilon_{jidt} \quad (4)$$

where $\Delta v_{jidt} \equiv \log v_{jid,t} - \log v_{jid,t-1}$ denotes the growth of export volume of product j in industry i from Korea to destination country d between year t and $t-1$. To address a possible seasonality problem, I only use the first half year's exports in each year in the dataset. Thus, the dependent variable is the growth rate of exports between the first half of the year $t-1$ and the first half of the year t. Note that v_{jidt} denotes exports of the first half of year t, and v'_{jidt} indicates exports of the full-year t. The time dimension comprises two periods: $t \in \{2009, 2015\}$, which are the periods of trade collapse and trade drop. T_t is a dummy variable, which is one if the period is 2015 and zero if the period is 2009. W_{dt} is a vector of two variables that contain country-level characteristics: one is a destination dummy variable, which is one if the destination d is an emerging country and zero otherwise. Another variable in the vector W_{dt} is the income (GDP) growth rate of the destination country. δ_i is the industry fixed effect and ϵ_{jidt} is an error term.

The TRASS dataset tells me the total volume of exports of product j to destination country d by the size of firms, small, medium, and large. For example, Korea exported 1.31 million

USD worth of HS 6-digit product 820570 (vices, clamps, and the like) to China in the first half of 2008. Of 1.31 million USD, large firms sold 1.26 million USD, medium firms sold 0.4 million USD, and small firms sold 0.01 million USD. I omit the firm dimension in the subscripts of the dependent variable in equation (4) for brevity, but I report results for each group of firms. The industry classification for the industry dummy variable is from TRASS, which contains 69 industries. The statistics of the yearly growth rate of GDP of destination countries are from the IMF World Economic Outlook.

Table 3 reports descriptive statistics. The dataset contains 255,916 observations, of which 21 percent are large firms, 21 percent are medium firms, and 56 percent are small firms.[12] According to Table 7, medium firms' average growth rate of the export volume is the lowest. Specifically, while the average export growth rate of both medium firms (-60 percent) and large firms (-60 percent) went down on average during the periods of trade collapse and trade slowdown, the average growth rate of export volume of small firms (23 percent) went up. Note that the average size of the export volume is highest for large firms and lowest for small firms as one can expect. The regression analysis can shed light on why the growth rate of exports during trade collapse and slowdown differ by firm sizes.

Table 7. Descriptive Statistics of the Dataset for the Estimation of Eq. (7)

Var.	Firm Size	Obs.	Mean	Std. Dev.	Min	Max
Δv_{jidt}	All	255,916	-0.122	3.05	-17.624	18.532
	Large	53,498	-0.3149	3.35	-17.624	18.532
	Med.	53,512	-0.6	3.181	-15.774	14.831
	Small	142,406	0.226	2.766	-17.006	16.297
v'_{jidt}	All	255,916	1,646,328	3.60E+07	1	7.58E+09
	Large	53,498	4,995,152	7.61E+07	1	7.58E+09
	Med.	53,512	1,336,513	1.85E+07	1	2.77E+09
	Small	142,406	574,129	4,221,590	1	4.46E+08
T_{dt}	All	255,916	0.582	0.49	0	1.00E+00
GDP Gr.	All	255,916	1.57	4.44	-28.1	2.63E+01

Note: Δv_{jidt} is the growth of export volume of product j in industry i to destination country d between periods t and $t-1$; v'_{jidt} is the unit of yearly exports to a country-product pair in year t, whose unit is USD. T_{dt} is one if the period is 2015 and zero if the period is 2009. The GDP growth is the year-on-year growth rate in percentage.

Source: Authors' calculation using data from TRASS, IMF World Economic Outlook.

Panel A in Table 8 provides the numbers of products or the extensive margin of exports by the size of the firm. The product count is 4,386 in total across firms. While small firms cover 98 percent of all exporting products by South Korea, large firms cover 66 percent, and medium firms cover 75 percent of all exporting products. Combining this information with Table 7, we can see that small firms export more product varieties but the volume of export per product is lower compared to large firms. Large firms export 5 million USD to a country-product pair on average, which is 8.7 times larger than the small firms' average exports to a country-product pair. Among all exporting products, the share of intermediate goods is 61 percent and it is similar for all sizes of firms. Panel B in Table 8 provides the number of export destination countries each firm group serves. Korean firms export to 148 emerging countries

[12] The remaining 2 percent does not have the firm size information.

and 39 advanced countries overall. The statistics are similar for large, medium, and small firms.

In equation (4), A positive and significant β_1 for the emerging country variable will show that export growth to emerging countries was higher than that to advanced countries in 2009, after controlling for the changes in exports due to GDP growth. Such a result will be consistent with the claim that the Great Trade Collapse was more severe among developed countries. It is important to note that I control for the GDP growth rate in the regression. Thus, I measure the effect of the destination countries in 2015 compared to 2009, which is a 'pure' country effect. Intermediate goods export is about 2/3 of all Korean exports to emerging countries, and 1/3 of all Korean exports to advanced countries. Thus, the 'pure' country effect considers the composition of goods rather than the income growth effect.

Table 8. Number of Exporting Countries and Products

A. Number of Products

Product Type	Firm Size			
	Pooled	Large	Medium	Small
Total	4386	2884	3288	4286
Intermediate	2683	1727	2015	2617
Capital	601	467	473	592
Consumption	1068	668	776	1046

B. Number of countries

Country Type	Firm Size			
	Pooled	Large	Medium	Small
Total	187	178	181	185
Emerging	148	140	143	146
Advanced	39	38	38	39

Note: The product type is classified using Basic Economic Categories, and the country type is classified following IMF.

Source: Authors' calculation using data from TRASS and Broad Economic Categories from United Nations Statistics Division.

A negative and significant β_2 for the emerging country variable will show that Korean export growth to emerging countries weakened in 2015 compared to 2009, which is consistent with the claim that weakening emerging economies partly caused the trade slowdown. If the sum of β_1 and β_2 is positive, then the average export growth to developing countries was higher than the average export growth to advanced nations in 2015.

I present the results of the estimation in Table 9. β_1's are positive and significant for all categories of products in the case of large firms, but negative and significant in the case of small firms. The change in export growth rate to emerging countries during the 2008-09 trade collapse was 28 percent higher than advanced countries for large firms' intermediate trade. Thus, Korean exports to emerging countries by large firms did stay resilient in 2009 compared to exports to developed countries. But the change in export growth rate during 2008-09 to developing countries was 18.2 percent lower for small firms' intermediate trade. Such a severe drop in exports to emerging countries by small firms is prevalent other product categories: -31.5 percent for capital goods and -38.1 percent for consumption goods (and -41.7 percent for durable consumption goods).

As expected, the signs reverse for β_2's. They are negative but largely insignificant for large firms. The large firms' export growth to emerging countries is 1.3 percent lower than export

growth to advanced countries in 2015 compared to 2009, but the effect is statistically insignificant. The β_2 coefficient is negative and significant for medium firms for consumption goods. Overall, the export growth of medium-firm exports to emerging countries dropped for all products, and by 42.7 percent for consumption goods in 2015 compared to 2009. The results imply that the 2015 trade drop was due to weak demand in the emerging countries suffering from low oil prices. A stronger drop in consumption goods exports to these countries is the evidence. Then why did medium firms more severely suffer than large firms during the trade slowdown? One possibility is that while the trade collapse was shockingly sudden, the 2015 trade drop occurred after more than two years of trade slowdown. And it is possible that larger firms were able to stay more stable than medium firms thanks to their uncertainty managements.

Table 9. Results of the Differences-in-Differences Estimations

	Intermediate		Capital		Consumption	
A. Large	β_1	β_2	β_1	β_2	β_1	β_2
Emerging	0.2800***	-0.0961	0.3040**	0.0016	0.2550*	-0.0178
	(0.0658)	(0.0842)	(0.1280)	(0.1580)	(0.1310)	(0.1570)
GDP Gr.	0.0047	-0.0132	0.0212*	-0.0200	0.0117	-0.0329*
	(0.0065)	(0.0097)	(0.0115)	(0.0165)	(0.0131)	(0.0192)
Obs.	32,107		10,760		9,176	
R-sq.	0.039		0.026		0.055	
B. Med.	β_1	β_2	β_1	β_2	β_1	β_2
Emerging	0.0992	-0.0194	0.1820	-0.3070*	0.4900***	-0.4270***
	(0.0698)	(0.0838)	(0.1360)	(0.1600)	(0.1080)	(0.1340)
GDP Gr.	-0.0218***	0.0276***	-0.0227*	0.0439**	0.0006	-0.0171
	(0.0067)	(0.0094)	(0.0124)	(0.0171)	(0.0111)	(0.0167)
Obs.	32,732		9,515		10,832	
R-sq.	0.002		0.008		0.029	
C. Small	β_1	β_2	β_1	β_2	β_1	β_2
Emerging	-0.1820***	0.0828*	-0.3150***	0.1040	-0.3810***	0.0292
	(0.0320)	(0.0429)	(0.0560)	(0.0725)	(0.0511)	(0.0671)
GDP Gr.	0.0331***	-0.0043	0.0354***	-0.0105	0.0605***	0.0037
	(0.0032)	(0.0053)	(0.0052)	(0.0079)	(0.0055)	(0.0084)
Obs.	79,959		29,875		31,390	
R-sq.	0.015		0.012		0.016	

Notes: 1. β_1 is the coefficient of W_{dt} and β_2 is the coefficient of $W_{dt} \times T_t$ in equation (4). Robust standard errors in parentheses.
2. *p<0.1, **p<0.05, ***p<0.001.

Source: Authors' calculation using data from TRASS, IMF World Economic Outlook, and BEC.

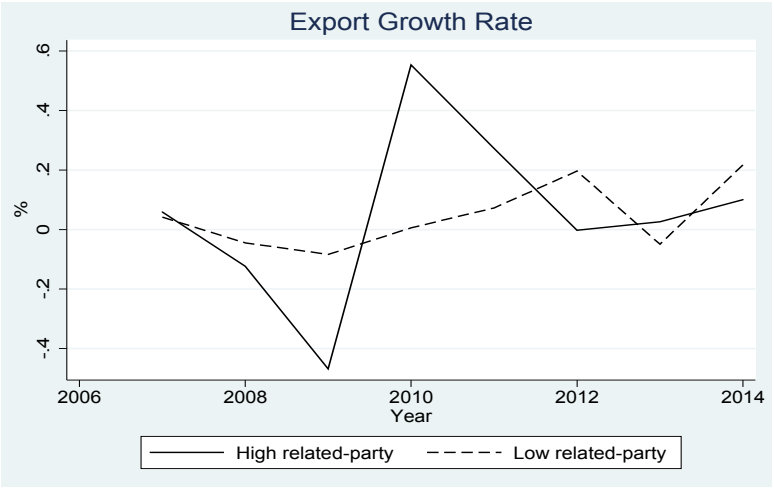
The β_2 coefficients for small firms are positive and significant, indicating that the small firms' export growth of intermediate goods to emerging countries is 8.2 percent higher in the 2015 trade drop than in the 2009 trade collapse. But a caveat here is that the exports by small firms most severely dropped among all groups of firms in 2009. As explained above, the sum of β_1 and β_2 is the effect of emerging countries on Korea's exports in 2015, and it is still the lowest for small firms' intermediate goods, -0.10, where the sum is 0.18 for large firms and

0.08 for medium firms. Thus, exports of small firms to emerging countries hurt the most during the trade drop in 2015, but they did better compare to when the financial crisis hit. The export of large and medium firms to emerging countries were hurt more in 2015 compared to the trade collapse.

It is interesting that, after controlling for the GDP growth rates, the export drop in 2015 to emerging countries was more severe among large and medium firms than that of small firms. Such differing patterns between large and medium firms versus small firms hold in all goods categories except for the capital goods categories of medium firms. Investigating the reason behind the relatively sound performances of small firms will be a meaningful future research topic.

4.3. Intrafirm Trade

Fig. 4. Growth Rates of Related-Party Exports to the U.S.



Note: The left axis indicates the year-on-year growth rates of high and low related-party exports from Korea to the US. The high (low) related-party group captures exports by the industries whose share of related-party exports out of total exports is below (above) the first (third) quartile.

Source: Authors' calculation using data from Trade Statistics Service, Related-party trade database from the US Census.

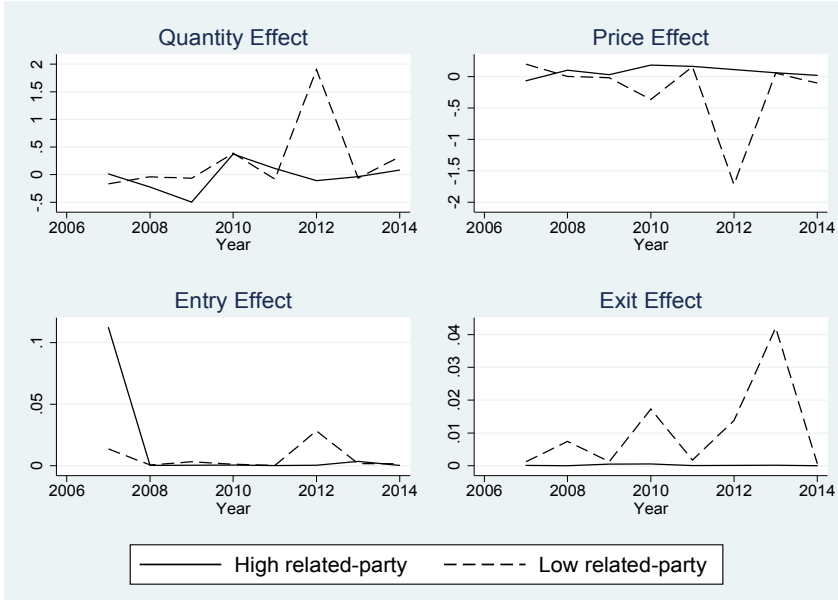
Bernard et al. (2009) report that international transactions between related parties, or intrafirm trade, stayed mostly intact during the Asian financial crisis in 1997, and Altomonte et al. (2012) shows that intrafirm trade dropped and recovered faster than arm's length trade during the Great Trade Collapse. I ask whether Korean intrafirm trade is relatively intact during the trade collapse in 2009 and the recent trade slowdown. Unfortunately, access to Korean intrafirm trade statistics is restricted as of now, and there is no public source of the data. But I measure the intrafirm trade between Korea and the US by combining two available datasets. One is TRASS and the other is the US related-party trade database from the US Census. The related-trade database offers information about all international transactions between the US and all of its bilateral trading partners at the 5-digit NAICS (North American Industrial Classification) level. For each industry and year, the database reports total transac-

tions, related-party transactions and non-related party transactions for both export and import. A transaction is classified as a related party if one party of the transaction owns more than 10 percent of the other party in the case of exports and more than 6 percent in the case of imports. Thus related-party transaction information is often used as a proxy of intrafirm trade in the international trade literature. I use the information on the share of intrafirm trade between the US and Korea in each NAICS 5-digit industry i and year t

$$(\text{Intrafirm Share})_{it} = \frac{(\text{Total Related} - \text{Party Transactions})_{it}}{(\text{Total Transactions})_{it}}$$

from the related-trade database.

Fig. 5. Decomposition of Related-Party Exports Growth



Note: Growth rates in Fig. 4 is decomposed into the four effects above. For each year, the sum of the quantity effect, price effect, and entry effect minus exit effect is 1.

Source: Authors' calculation using data from Trade Statistics Service, Related-party trade database from the US Census.

I match the related-party trade database with the Korean export statistics from TRASS using the concordance table between NAICS 5-digit and HS 6-digit published from the US Census Bureau. The sample periods are from 2006 to 2014, since 2014 is the most recent statistics. The related-party trade database gives the intrafirm trade share information for each HS 6-digit product. I repeat the decomposition exercise of Section 2 for the group of products whose related-party share is above the third quartile, which I call 'high related-party' and another group of products below the first quartile, which I call 'low related-party.' I use the high related-party share group as a proxy for intrafirm exports, and the low related-party share group as a proxy for arm's length exports to the US from Korea.

Fig. 4 presents the year-on-year export growth rate separately for the high and low related-party group. Intrafirm trade fluctuated more but recovered faster during the Great Trade Collapse, and stayed more stable during the slowdown. The response of intrafirm trade during the GTC is similar to that of French intrafirm trade reported by Altomonte et al. (2012) in that the intrafirm exports to the US promptly adjust to the macroeconomic shock. The high related-party exports dropped by 46.8 percent in 2009 and recovered by 55.3 percent in 2010, whereas the low related-party exports declined by 8.3 percent in 2009 and improved by 0.6 percent in 2010. Thus, although the intrafirm trade between Korea and the US dropped more than the arm's length trade during the GTC, intrafirm trade also strongly recovered in the subsequent years. The pattern of deeper drop and faster recovery is found in the aggregate export flows during the GTC, and it could be the case that large firms, which are the majority of the exports, are involved in the intrafirm trade.

Fig. 5 shows the decomposition of the growth rate into quantity, price, entry, and exit effects. I do not run OLS regressions for intrafirm trade between Korea and the US because there is only one observation (country) in each year. The decomposition results show that the high related-party group stayed stable in price, entry, and exit effects throughout the years. The quantity effect of high related party exports fell by 49.8 percent in 2009, reflecting the massive drop of intrafirm exports in 2009. But the price effect of high related-party fell by only 6.7 percent in 2009, showing that the trade drop of 2009 was mostly due to the quantity effect. The pattern is similar in low related-party trade. In later years, when trade slowdown has continued, all four effects of the high related-party stay more stable than the low-related party. In 2012, when the low related party's quantity effect jumped, and its price effect dropped, the four effects of the aggregate export from Korea to the US have the same patterns. Thus, it seems that, unlike the total export fluctuations in quantity and price effects, intrafirm trade, at least with the US, stayed more stable and resilient during the period of slowdown.

5. Conclusion and Policy Implications

Observing the unusual trade trend of the world and Korea in the last decade, I investigate detailed features of the trade collapse and slowdown at both aggregated and disaggregated levels. I show that low oil prices accompany Korea's recent export drop in 2015. However, there is evidence that points to the structural changes in exports. The long-run trade-income elasticity has shrunken after the global financial crisis, and Korea's bilateral trade barriers with most of the important trading partners have tightened since 2011.

I also present evidence regarding the heterogeneities in disaggregated trade flows. Overall, the exports of large corporations are more resilient than that of medium and small enterprises during the trade collapse and slowdown, but small firms fared better during the trade slowdown than the trade collapse. I provide rare evidence regarding Korean intrafirm exports' stability during the period of trade slowdown. In the long run, analyzing value-added exports would help understand the current slowdown of international trade when the value-added data for the current years are available in the future.[13]

The results of this paper offer various policy implications. First, to lower the adverse effect of oil price fluctuations on export growth, it is essential to diversify the export products. Korea's export prices are strongly affected by oil prices since Korea ultimately depends on foreign sources when it comes to supply oils. But there is a way to lessen the negative effect of

[13] Since the export value-added database from the world bank or OECD covers until 2011, it is hard to know how value-added exports changed during the trade slowdown periods as of now.

oil price fluctuations. Haddad et al. (2010) point out that, in the US, during the global financial crisis, the prices of homogenous goods plunged but the prices of differentiated products stayed stable. It was similar in Korea during the trade slowdown period. According to the Bank of Korea, between 2012-2016, export prices of chemical, primary metal, and coal and petroleum products fell most while the export prices of transport equipment and general machinery hardly changed. Thus, diversifying the export products to include more differentiated products would lower the temporary price effects due to oil price fluctuations.

Second, because the long-run trade-income elasticity of the world has shrunken, it is likely that the future export growth would be modest, unlike before the mid-2000s. China's average growth rate in 2002-11 was 10.6 but was 7.4 in 2012-15, according to the IMF. As China is transforming itself from 'the factory of the world' into a domestic-consumption-centered economy, international trade through global value chains would continue to be slow. Policymakers need to have a long-run perspective and be ready to navigate the age of slow trade to maximize the benefit of international trade.

Third, while bilateral trade barriers between Korea and its principal trading partners are universally increasing, the trade barriers of Vietnam have continuously lowered since 2000. The diminishing trend of the trade barriers between Korea and Vietnam has been intact during the period of the trade collapse and slowdown. It seems, therefore, likely that the trend will continue in the future, and such a pattern may apply to the trade barriers between Korea and other ASEAN countries. Korea has free trade agreements in effect with both Vietnam and ASEAN, but the utilization rates of the two FTAs are low at 36.0 percent and 52.3 percent as of 2016. Therefore, it will be beneficial to enhance the utilization rates through economic cooperation with Vietnam and other ASEAN countries.

Lastly, at a disaggregated level, export flows show heterogeneous patterns depending on firm sizes, product categories, destination countries, and organization mode of exports. Results of Section 4 identify robust export flows during the recent slowdown and drop, on which policymakers can pay attention and encourage to be the primary export industries in the age of slow trade. The share of exports by small firms has been rising during the slowdown period, according to the Korea International Trade Association, which is encouraging. Thus, policymakers may further support small firms by helping them to transform their manufacturing facilities into smart factories to boost up productivity and by effectively operating export finances, which small Korean firms request most as export policies.[14] Also, as emerging countries are expected to continue their slow growth in the near future, exports, especially consumption goods, to advanced countries, will be promising. Given the mild price effects in the growth of intrafirm exports, it is worth noting that FDI-induced exports may contribute to the stabilization of export flows.

References

Abe, M. and M. Proksch (2017), "Supporting Participation of Asia-Pacific SMEs in Global Value Chains", *Journal of Korea Trade*, 21(2), 86-106.

Altomonte, C., F. Di Mauro, G. I. P. Ottaviano, A. Rungi and V. Vicard (2012), "Global Value Chains During the Great Trade Collapse: A Bullwhip Effect?", *Firms in the international economy: Firm heterogeneity meets international business*, 277-308.

Ariu, A. (2016), "Crisis-Proof Services: Why Trade in Services Did Not Suffer During the 2008–

[14] See Abe and Proksch (2017) for more discussion on obstacles of Asia-Pacific small and medium firms face in terms of participating in gloval value chains.

2009 Collapse", *Journal of International Economics*, 98, 138-149.

Baldwin, R. E. (2009), *The Great Trade Collapse: Causes, Consequences and Prospects,* London: Center for Economic Policy Research.

Bems, R., R. C. Johnson and K. M. Yi (2010), "Demand Spillovers and the Collapse of Trade in the Global Recession", *IMF Economic Review*, 58(2), 295-326.

Bernard, A. B., J. B. Jensen, S. J. Redding and P. K. Schott (2009), "The Margins of US Trade", *The American Economic Review*, 99(2), 487-493.

Bussiere, M., G. Callegari, F. Ghironi, G. Sestieri and N. Yamano (2013), "Estimating Trade Elasticities: Demand Composition and the Trade Collapse of 2008-2009", *American Economic Journal: Macroeconomics*, 5(3), 118-151.

Constantinescu, C., A. Mattoo and M. Ruta (2015), *The Global Trade Slowdown: Cyclical or Structural?* (IMF Working Paper, No. WP/15/6), Washington, DC: International Monetary Fund.

Eaton, J., M. Eslava, M. Kugler and J. Tybout (2008), "Export Dynamics in Colombia: Firm-Level Evidence". In E. Helpman, D. Marin and T. Verdier (Eds.), *The Organization of Firms in a Global Economy*, Cambridge, MA: Harvard University Press, 8, 231-272.

Eaton, J., S. Kortum, B. Neiman and J. Romalis (2016), "Trade and the Global Recession", *The American Economic Review*, 106(11), 3401-3438.

Escaith, H., N. Lindenberg and S. Miroudot (2010), *International Supply Chains and Trade Elasticity in Times of Global Crisis* (World Trade Organization Staff Working Paper, No. ERSD-2010-08), Geneva, Switzerland: World Trade Organization.

Evenett, S. and J. Fritz (2015), *The Tide Turns? Trade, Protectionism, and Slowing Global Growth,* London: CEPR Press.

Gopinath, G., O. Itskhoki and B. Neiman (2012), "Trade Prices and the Global Trade Collapse of 2008–09", *IMF Economic Review*, 60(3), 303-328.

Haddad, M., A. Harrison and C. Hausman (2010), *Decomposing the Great Trade Collapse: Products, Prices, and Quantities in the 2008-2009 Crisis* (NBER Working Paper, No. 16253), Cambridge, MA: National Bureau of Economic Research.

Hoekman, B. (2015), *The Global Trade Slowdown: A New Normal*, London: Center for Economic Policy Research.

Levchenko, A., L. Lewis and L. Tesar (2010), "The Collapse of International Trade during the 2008–09 Crisis: In Search of the Smoking Gun", *IMF Economic Review*, 58(2), 214-253.

Novy, D. (2013), "Gravity Redux: Measuring International Trade Costs with Panel Data", *Economic Inquiry*, 51(1), 101-121.

Ro, S. (2012), "South Korean Trade Data Is the Most Important Economic Indicator in the World", *Business Insider*. Available from https://www.businessinsider.com/south-korean-trade-data-most-important-economic-indicator-2012-5 (accessed January 20, 2013)

UNCTAD (2016), *Key Indicators and Trends in International Trade*, Geneva, Switzerland: United Nations Conference on Trade and Development.

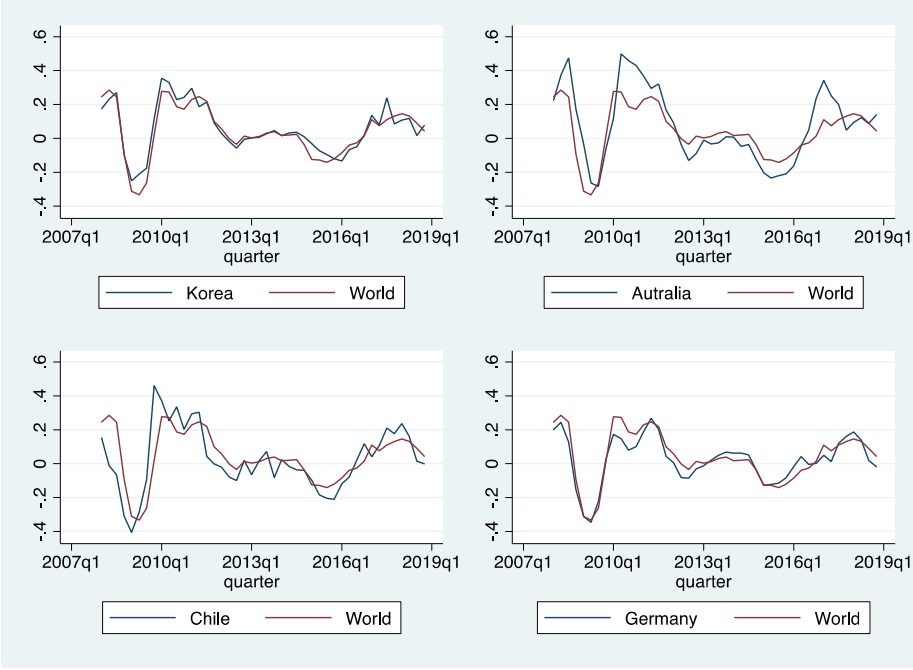
Wei, S. J. (1996), *Intrnational versus International Trade: How Stubborn Are Nations in Global Integration?* (NBER Working Paper, No. 5531), Cambridge, MA: National Bureau of Economic Research.

Appendices

A. Export Growth Rates of Korea, Australia, Chile and Germany

Fig. A compares the quarter-on-quarter export growth rates of Korea and other small open countries (Australia and Chile) and another manufacturing-heavy country (Germany). Korea's export growth rate more closely moves with the world's export compared to all three countries.

Fig. A. Export Growth Rates of the World and Selective Countries



Notes: The vertical axis indicates the quarter-on-quarter growth rates of aggregate exports of the respective country and the world.
Source: Authors' calculation using data from IMF DOTS.

B. Data Sources of the Goods Part GDP

Table A lists the data sources used to calculate the goods part GDP. All goods part GDP statistics are nominal millions of USD. Since the goods part GDP statistics are initially in local currency, I convert them to millions of US dollars using the quarterly average exchange rate from 1) Bank of Korea for Korea, China, Japan, Singapore, and Vietnam, 2) Bloomberg for Australia, Germany, Hong Kong, Saudi Arabia, and 3) Central Bank of Republic of China (Taiwan) for Taiwan.

Table A. Data Sources of the Goods Part GDP

Country	Source
Republic of Korea	Bank of Korea
China	National Bureau of Statistics of China
US	Bureau of Economic Analysis
Japan	Federal Reserve Economic Data
Vietnam	General Statistics Office of Vietnam
Hong Kong	Census and Statistics Department of Hong Kong
Taiwan	Directorate General of Budget Accounting and Statistics
Singapore	Statistics Singapore
Australia	Australian Bureau of Statistics
Germany	Eurostat
Saudi Arabia	Saudi Arabian Central Department of Statistics

C. Results of the Unit Root and Cointegration Tests

Table B shows the results of the unit root tests for the variables used in the Error Correction model in Section 3. The p-value in the table is MacKinnon approximate p-value for $Z(t)$. The result shows whether the hypothesis that there exists a unit root is rejected or not. The hypothesis rejected for the first difference series of Korean exports and GDP. Table B shows the results of Johansen cointegration tests. The Korean exports and world GDP have the cointegration rank of one.

Table B. Phillips-Perron Unit Root Test Results

Variable	Interpolated Dickey-Fuller			P-Value	Result
	1% critical value	5% critical value	10% critical value		
Korean export	-3.495	-2.887	-2.577	0.3156	unit root
World GDP	-3.563	-2.920	-2.595	0.3169	unit root
First difference of imports	-3.495	-2.887	-2.577	0.0000	no unit root
First difference of GDP	-3.565	-2.921	-2.596	0.0000	no unit root

Source: Authors' calculation.

Table C. Johansen Test Results for Cointegration

Maximum Rank	Parms	LL	Eigenvalue	Trade statistics	5% critical value
0	6	233.36	.	10.3778 *	15.41
1	9	236.68	0.1045	3.7524	3.76
2	10	238.56	0.0606		

Source: Authors' calculation.